the aesthetic of play

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Set in Stone Sans and Stone Serif by Toppan Best-set Premedia Limited, Hong Kong. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data are available

ISBN: 978-0-262-02851-6 (hardcover : alk. paper)

10 9 8 7 6 5 4 3 2 1

2 Interactivity

It is taken as a given within the game industry that the major difference between games and other forms of popular entertainment is interactivity. To play is to engage in a dialogue—information flows back and forth between player and game. With film, literature, theater—pretty much everything else—the flow of information is one way only. When you watch a movie or read a book, you aren't engaging in a dialogue; you are listening to a monologue.

This critical stance is very deeply ingrained. Every year the Academy of Interactive Arts and Sciences gives out the Interactive Achievement Awards to deserving game developers. There are game companies named Take-Two Interactive and Disney Interactive. Numerous digressions on videogames begin with a quick nod to their special interactive nature and how much they differ from traditional linear media.

Typically, non-electronic games and sports are also included under the umbrella of interactivity. When you play tennis, there is clearly a back-and-forth between you and your opponent. Information is flowing in both directions. The "interactive" label isn't intended to distinguish videogames from other games and sports. Rather, it is intended to draw a sharp distinction between games of all sorts and other more "passive" forms of entertainment.

Interactivity is, by definition, active. It's the give-and-take between player and rule system. I press a button on my controller and information is communicated to the game. The game updates the image on the screen, feeding information back to me. This new information provides the context for my next move. My actions influence the game and the game influences my actions in an ongoing chain of cause and effect (figure 2.1).

Although this way of representing interactivity may be accurate, it is trivial. It doesn't provide much insight into how games actually function

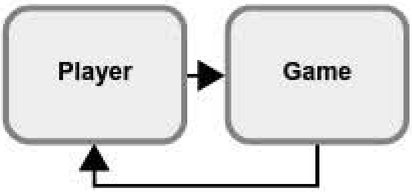

Figure 2.1
A very simple model of interactivity.

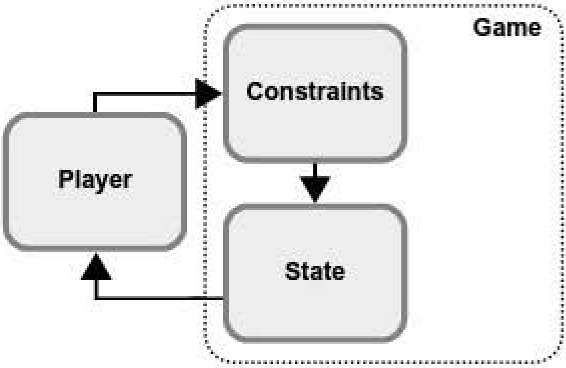

Figure 2.2
A slightly more complicated model of interactivity.

as play experiences. After all, even dull games usually do *something* when you press a button; interaction alone isn't enough to make a game interesting to play. For a game to be interesting, it must respond to our actions in certain very particular ways. And if we are going to understand what those ways are, we need to construct a more complicated conceptual framework of interactivity.

Let's begin by breaking the game down into two sub-components: constraints and state (figure 2.2). The constraints determine which moves are permitted; the state is an evolving record of the player's movement within the system. The constraints are fixed; the state is fluid. This fits nicely with our definition of play ("Free movement within a system of constraints"); it is also a very natural way to think about all sorts of games. Consider chess, for example. The rules of chess are a fixed set of constraints. (In fact, they have remained constant across millions of games played over hundreds of years.) However, the state of a game of chess—the arrangement of pieces on the board—changes with every move.

We can make a similar distinction with videogames. The contents of a game disk are fixed. All copies of the game that emerges from the manufacturing plant are identical. Every time I insert a disk into a game console, the same code and data—the same fixed constraints—are loaded. But as I play the game, things change. I move around. My health fluctuates. My character learns new skills. In addition to the fixed constraints I've loaded off the disk, there is a fluid state that changes from moment to moment. And if I'm forced to interrupt my game, I can copy this state to a save file so I can continue playing later.

Dividing games into constraints and state allows us to make a valuable distinction between the framework that structures a play experience and the play experience itself. A game isn't just a system of rules considered in isolation; it is also the pattern of movement that emerges within the playfield that the rules define.

Furthermore, although the set of constraints defining a play space may be fixed, their individual relevance varies during play. Every constraint doesn't structure every move. Depending on the state of the game, some constraints will play a large part in structuring our current actions and some constraints will play no part at all. For example, in chess the rules for castling apply only when the king and the rook are in particular positions. If that configuration of the board isn't an element of the current state, the rule for castling can be ignored. Similarly, when we play a videogame, our constraints change dramatically every time we advance to a new level. The constraints that defined level 2 don't affect our actions after we move on to level 3.

We can think of the set of constraints for a play space as divided into *active constraints* and *potential constraints*. An active constraint affects our actions right now; a potential constraint may affect us at some time in the future, or may have affected us at some time at some time in the past (figure 2.3).

During the course of play, changes in the state can cause potential constraints to become active, and can cause active constraints to recede back into mere potentiality. In fact, it is possible for some potential constraints to never become active. Think of a chess match in which neither player advances a pawn to the far side of the board, and the rule for pawn promotion thus never comes into play. Or think of a videogame that has a secret level that you never unlock. Similarly, particularly important active constraints may remain active through the entire game. The high-level constraint "stay on the road" structures every action we take during a racing game, even while the transient constraints provided by the geometry of the track and the positions of the other cars continually flicker in and out of potentiality.

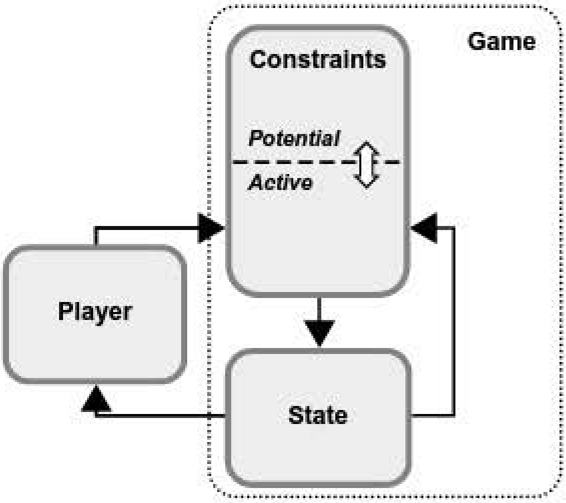

Figure 2.3
An even more complicated model of interactivity.

Constraints act as a filter on intent. They determine what changes to the state are allowed. But at the same time, the state determines which rules are active. This reciprocal relationship between constraints and state creates a situation in which both our position within the overall system and the immediate restrictions on our moment-to-moment actions are continually shifting and evolving.

What is useful about this way of thinking about play is that it focuses analysis of the play experience squarely on the evolving active constraints. It is easy for a game designer to get caught up in the global architecture of a rule set, and to conceptualize the entire play space as a static structure with certain affordances and restrictions. But from the player's perspective, the large-scale structure of the rules is invisible. From the player's perspective, the play experience consists of an unfolding encounter with a small but variable set of active constraints. And the quality of that experience is determined largely by the game's capacity to vary those active constraints in interesting or even seductive ways.

Deconstructing Interactivity

Now let's ask what seems to be a simple question: When we're playing a game of chess, where are the rules?

The location of the state is obvious. The board is on the table in front of us. The pieces are arranged in their proper positions. If we are using a chess clock, it is sitting next to the board. But where are the rules?

If we are novice players, the rules may be written on the back of the box the chess set came in. Or they might be in a book on a bookshelf behind us. Or they might be displayed on a computer screen nearby. The interesting thing, though, is that unless we are novice players the rules will not be consulted during the game. The rules of chess are written down in millions of locations around the world, but when you are actually playing a game of chess those physical manifestations of the rules aren't a part of the process. When you are actually playing a game of chess, the only rules that matter are the rules in your head.

As the game historian David Parlett writes,

> There is a widespread assumption that all games have official rules that are recorded in writing. But it is mistaken. For one thing, most games are not book games but folk games, being transmitted by word of mouth, example and practice. For another, even where written rules *do* exist, probably no folk games and certainly very few book games can lay claim to a widely recognised governing body responsible for authorizing them. ... The most basic level of experience suggests that the rules of a game are something inherent in the game itself—or, more accurately (since a game is essentially a mode of behavior), an abstraction existing in the minds of all its players.[1]

The importance of this is hard to overstate. It is customary to think of players and games as distinct and separate entities. But when we take a hard look at a game such as chess, we discover that this distinction is illusory. The rules are clearly an essential part of the overall system of the game, but for all practical purposes they exist only in the heads of the players. The game isn't a separate entity that stands in isolation from the players; it is a hybrid of external components (the board, the pieces) and internal mental states.

Every game has constraints and a state. But those constraints and that state may not necessarily have a separate physical existence from the player. It is possible for a game to exist partially, or even wholly, inside the minds of its players (figure 2.4).

Some constraints are outside the player's head. These *external constraints* are imposed upon the player by some outside force—a baseball umpire, for example. And some constraints are inside the player's head. These *internal constraints* are, like the rules of bridge, imposed by the player on himself.

Similarly, some elements of the state are outside the player's head. A chessboard and chess pieces are an example of *external state*. But at the same time there are elements of *internal state* that exist only inside the player's

1. Parlett, "Rules OK or Hoyle on Troubled Waters."

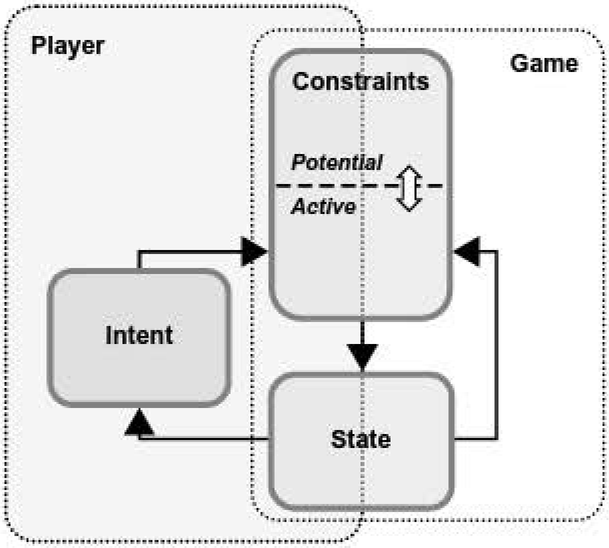

Figure 2.4
Blurring the line between player and game.

head—whose turn it is, for example.[2] In fact, if you are a good enough chess player, you can do away with the board and the pieces and hold the entire state of the game in your mind. Grandmasters sometimes play blindfolded as a stunt. The externality of the state of a game of chess is really just a notational convenience. The game plays the same even if the state is entirely internal and players make moves by calling them out to each other.

Different games draw the boundary between internal and external in different ways. For example, in a game of soccer the constraints have a large internal component. The players themselves know what is allowed and what is forbidden and tailor their actions accordingly. However, professional soccer games are played with a referee, who provides additional external reinforcement of the rules. On top of that, soccer has a number of physical constraints—the shape of the pitch, the natural capabilities of the human body, the dynamic properties of the ball, and the laws of physics themselves. These are obviously external.

Most traditional games rely heavily on internal constraints. Even when a referee is present, most players are self-policing. Videogames make much

2. Often games require that players maintain consensus about elements of their internal state. If I am playing chess with you, we must agree on whose turn it is in order for the game to proceed. However, maintaining this internal state generally doesn't require any communication between us. We track it independently, and talk about it only if one of us makes a mistake or attempts to cheat.

greater use of external constraints—the player doesn't participate in enforcing them. The contrast is obvious if we compare the computer version of a game with its real-world counterpart. When I play real-world solitaire, I make a conscious decision not to peek at the hidden cards. But when I play solitaire on my laptop, peeking isn't possible. Enforcing that constraint has been taken out of my hands.[3]

Because videogames depend heavily on the externality of their constraints, it is tempting to assume that they don't have an internal component at all. When I play a videogame, it is easy to imagine that all the obstacles I'm pushing against are all out there, in the outside world. What is in my head doesn't matter. But is that really true? Consider a sewer level in a typical action game. The slime-covered walls are a system of constraints that limit free movement through the space. If you run up against a wall, you stop. The game will not allow you to move further. But players rarely collide with the walls. The walls form a system of constraints, but players don't interact directly with it. Instead, they move through the space in such a way that they avoid obstacles before they collide with them. They have created an internal representation of the level inside their heads. They are aware of what the external constraints are, and they limit their actions accordingly. The external constraints still exist, but they are encountered only rarely. For the most part, when a player moves through a level, his actions are governed by the knowledge accumulated inside his brain—a set of internal constraints.

Learning how to play a game is often a matter of internalizing a set of external constraints. With chess, this process is explicit—we read the rules and memorize them. But with a videogame, we learn the rules mostly by experimentation. We jiggle the joystick and observe how our character responds. We collide with things to discover what blocks movement and what doesn't. We pick up a gun and shoot it to see how powerful it is. Step by step, we build an internal model of how the game world functions. As time goes by, our actions are structured less and less by the rules of the game and more and more by our understanding of those rules.

From this perspective, the entire notion of interactivity becomes suspect. Rather than treating play as a reciprocal exchange between player and game, it often makes more sense to view it as a player-centric activity that is sustained by occasional corrective nudges from an external system of

3. "Computer games *impose* the rules: they are not subject to discussion. Computer game rules are insurmountable laws the player has to acknowledge and surrender to in order to enjoy the game." Sicart, *The Ethics of Computer Games*, 27.

constraints. Game design then becomes less about building a system that responds in interesting ways and more about encouraging the formation of an interesting set of internal constraints in the mind of the player. Sometimes the former can result in the latter, but not inevitably.

Any theoretical framework that fails to take the role of internal constraints into account will necessarily exclude large swathes of the play experience from critical analysis. For example, the first major commercial game I designed was a first-person shooter—*Tom Clancy's Rainbow Six,* a tactical combat game about the actions of an international hostage rescue team. Most of its missions are rescue operations: sneaking into a barricaded building, killing (or avoiding) the terrorists inside, freeing their captives, and bringing them back out to safety.

Rainbow Six differs from other shooters in several important ways. For one thing, it has a targeting mechanic that penalizes the player for moving and shooting at the same time. Unlike other shooters that emphasize a "run and gun" style of play, the most effective tactic in *Rainbow Six* is to move through the levels carefully and methodically, much as a real hostage-rescue team does. A second important difference is a "one-shot kill" damage model. In contrast with games in which a character can safely absorb dozens of bullets, each of the characters in *Rainbow Six* can be killed by a single well-placed shot.

The result is an experience I have described as "entertaining claustrophobia." As you move through a level in *Rainbow Six*, your lines of sight are severely restricted. You never know where the next threat will come from, so even basic actions, such as turning a corner or stepping through a doorway, become fraught with danger. And because the combat mechanic restricts your ability to blast your way out of a bad situation, a lot of the gameplay revolves around anticipating danger and avoiding it. Thus, even an area entirely devoid of enemies can be packed with interesting gameplay. Moving down a corridor with doors on both sides is an exciting experience in *Rainbow Six*—not because the game is providing loads of feedback, but because the threat represented by the doors shapes the player's response to the space. In fact, during development we realized that even standing still and observing what is around you could be fun in the right circumstances, a discovery we put to use in the design of the follow-on titles *Rogue Spear* and *Ghost Recon.* In both of those games, the level-design team paid particular attention to how they structured the approach to threat zones, deliberately creating overlooks and cover locations where the player could safely pause and study the more dangerous terrain ahead.

Equating interactivity with play makes it difficult to understand the appeal of a game such as *Rainbow Six*. Because of the "one-shot kill" mechanic, the firefights in *Rainbow Six* tend to be over quickly, and so the amount of time the player spends actually interacting with the dynamic game system tends to be relatively low. Instead, the bulk of the gameplay in *Rainbow Six* is derived from the game's non-interactive moments: observing, anticipating, analyzing, planning. The abrupt and bloody gun battles serve primarily as exciting punctuation for the tactical game that plays out almost entirely inside the player's head.

Strategy as Internal Constraint

Sometimes it is hard to learn everything we need to know about a game through trial and error. More complicated games often begin with tutorials to make sure we internalize a minimal set of constraints before we begin to play. Or, if we get stuck further on, we can download a fan-created walkthrough to provide us with even more internal constraints, such as "Always use the grenade launcher when you're going up against large groups of enemies," "When you enter the warehouse level, take the door on the left," and "Don't go on the offensive until you have researched gunpowder."

Whereas tutorials teach basic rules, walkthroughs focus on strategies. Strategies are still constraints—they privilege certain lines of actions over others—but they are general guidelines, not hard-and-fast rules. Rather than telling us what we *can* do, strategies suggest what we *should* do.

Sometimes learning a minimal set of basic strategies is an important part of learning to play a game. For example, small children, when playing soccer, tend to congregate in a tight pack around the ball, kicking frantically. Nothing in the rules of soccer forbids playing the game that way, but it is more effective (and more fun) to spread players evenly across the field and assign them different roles. If you are coaching a children's soccer team, your job isn't just to teach them the rules of soccer, but also to teach them a collection of strategies that will structure their play experience in particular ways.

A few pages ago I noted that learning how to play is often a matter of internalizing external constraints. But that was an oversimplification. Learning how to play is a matter of constructing a minimal workable set of internal constraints. Sometimes that means memorizing rules, or discovering them through trial and error. But sometimes it means learning strategies—figuring out (or being told) effective ways to play within the rules. The effectiveness of a strategy is determined by how it interacts with the rules, but a strategy is not contained within the rules. The rules of chess never say "try to control the center of the board," even though controlling the center of the board is an effective strategy.

Besides learned rules and invented strategies, there are other types of internal constraints that structure our play experiences. Many games contain depictions of real-world situations. The characters we play often walk through simulated landscapes, or drive on simulated roads, or shoot simulated guns. In all these cases, the system of constraints that structures our play experience contains a large number of real-world expectations. When we run through a forest level in a videogame, we tend to follow simulated trails because we know from real-world experience that trails tend to be easier to traverse than crashing through the underbrush. We tend to skirt hills because we know that climbing up and down real hills is tiring. The fact that most games don't simulate these aspects of the real world is immaterial. Our set of internal constraints for navigating real terrain is so deeply ingrained that we unconsciously incorporate it into our strategies for navigating the simulation. In driving games, we unconsciously follow the rules of the road even if those rules are never enforced. In sports games, we avoid strategies that have little chance of success in the real world, regardless of how likely they are to work in the videogame world. In first-person shooters, we imbue computer-controlled enemies with human motivations and intentions, which leads us to overestimate or underestimate their capabilities.

In fact, the design of many videogames is predicated on the assumption that players will bring their real-world knowledge to bear in the construction of the play space. Nolan Bushnell stumbled upon this technique after his first game, *Computer Space*, was a commercial flop:

> You had to read the instructions before you could play[.] [P]eople didn't want to read instructions. To be successful, I had to come up with a game people already knew how to play; something so simple that any drunk in any bar could play.[4]

The result was *Pong*, the first commercially successful videogame. Although the goal of the simple back-and-forth tennis game was obvious, Bushnell did include one instruction to the player to help him construct the appropriate internal constraint: "Avoid missing ball for high score." Most modern games don't even go that far. Golf games assume you that you already know

4. Cohen, *Zap! The Rise and Fall of Atari*, 70–75.

that you're are supposed to put the ball in the hole, first-person shooters assume that you already know that you're supposed to shoot at the bad guys, and so on.

In addition to borrowing constraints from the real world, we also borrow constraints from other games. When I play a new racing game, I don't have to learn every nuance from scratch. I already have a large body of internal constraints that I've built up from years of playing other racing games. When I start up a game of *Split/Second,* my experience is partially structured by strategies I learned when I played *Burnout* years before, just as my experience with *Burnout* was partially structured by strategies I learned from *Ridge Racer*, and my experience with *Ridge Racer* was partially structured by strategies I learned from *Pole Position*, and my experience with *Pole Position* was partially structured by strategies I learned from *Night Driver*. Each new iteration of the genre is similar enough to its immediate predecessor that my existing body of internal constraints is still largely applicable. I already know how to drift, how to find the line, and how the AI-driven cars racing with me are likely to behave. New racing games are designed with the expectation that many players, like me, will already possess a particular body of constraints before they even begin to play.

From the player's perspective, it doesn't make much difference if an internal constraint is a learned rule, an invented strategy, or a distillation of real-world knowledge. If it privileges one line of action over another, it is a meaningful constraint. And if it's a meaningful constraint, then we should take it into account as part of our analysis of the play experience. If we are trying to understand how a game works, it isn't enough to just look at what the rules allow. We also have to look at what the player *thinks* the rules allow, the strategies the player invents on the fly, and the player's knowledge of similar games and similar situations in real life. All of these structuring elements are present in the active internal constraints, and each of them plays an important part in the unfolding of the play experience.

The Challenge of Design

We can group a game's constraints into four broad categories (figure 2.5):

The Game as Designed The static system of constraints that exists before the play experience begins—the rules written in the rulebook, or the software stored on the disk.

The Game as Encountered The active external constraints that influence the player's immediate actions—the rules that matter right now.

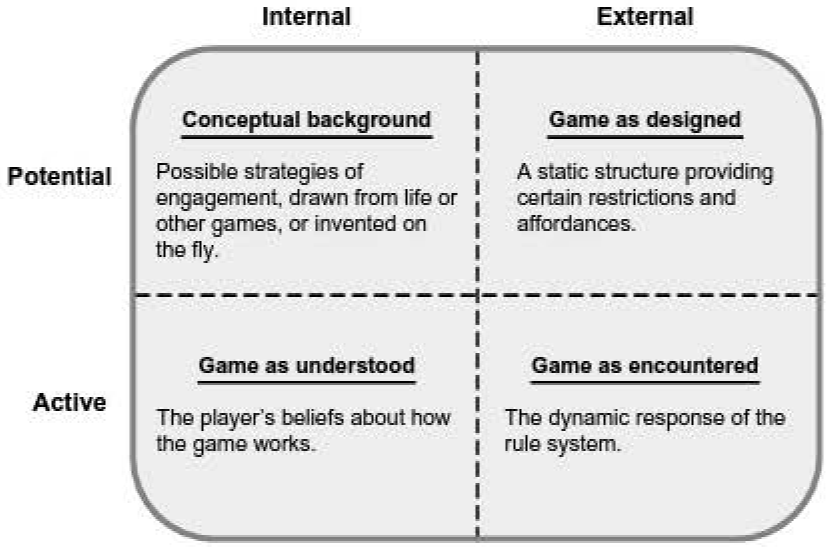

Figure 2.5
Varieties of constraints.

The Game as Understood The set of active constraints in the player's head—a mixture of internalized rules, invented strategies, and real-world knowledge.

The Conceptual Background The broad collection of potential ways that a player *might* engage with a game. How a player understands a game depends a great deal on the conceptual background the player starts with.

A game developer has direct control over only the game as designed—the external potential constraints. When I design a game, I am constructing a static framework of restrictions and affordances. But I don't have direct control over the dynamic response of this framework—the game as encountered. As the player moves freely through the game, his experience is shaped not by the rules as a whole, but by a fluctuating subset of active constraints.

Designers sometimes get caught up in the elegance of their rule system without thinking about how those rules translate into player experience. Years ago, I sat through a pitch for a space combat game. The designer went into great detail about an economic simulation his team was planning to create. The game universe would have dozens of planets, each with cities, farms, factories, and mines. AI-controlled merchant ships would shuttle raw materials and goods back and forth between the planets. Which cargos these ships carried would be determined by supply and demand, and commodity prices would fluctuate naturally in response to events such as natural disasters and political crises. It was a beautiful and well-thought-out rule system. However, the player played a space pirate. The action revolved entirely around raiding merchant ships and dodging naval vessels. Not only couldn't the player influence the overall economy, he didn't even have enough information about what was happening to understand it. A famine on the far side of the galaxy might change shipping patterns across half of the game's universe, but the player had no way of knowing that. From the player's perspective, the game's entire complex and subtle economic simulation was *experienced* as nothing more than a sequence of cryptic fluctuations in prices and cargoes. The entire economic model could have been replaced by a simple random number generator without changing the player's experience. The problem was that the designer was thinking about the economic system as an end unto itself rather than as an engine for generating player experience. If you are playing as a space pirate, the ships you attack should contain an interesting mix of cargo. Some planets should appear to be prosperous trading hubs, others impoverished backwaters. But the game need not simulate an entire economy to provide those sorts of external constraints. In fact, a complicated simulation can get in the way of constructing an interesting experience by generating constraints that are arbitrary or baffling. Salen and Zimmerman put it this way:

> The challenge ... is that the experience of play is not something that a game designer directly creates. Instead, play is an emergent property that arises from the game as a play engages with the system. The game designer creates a set of rules, which the players inhabit, explore and manipulate. ... The game designer only *indirectly* designs the player's experience by *directly* designing the rules.[5]

An important skill for any game designer is the ability to "see through" a set of rules—to be able to glance at a set of static rules and extrapolate the sorts of dynamic constraints they will generate during actual play. At the same time, a designer should be able to reverse the process—to reason backward from a desired player experience to arrive at a simple rule set that is capable of evoking it. Learning to roam easily back and forth across the conceptual gap between the game as designed and the game as encountered is an important step toward becoming a professional designer.

Another design challenge is bridging the gap between the game as encountered and the game as understood. Usually the existence of this gap is ignored; designers simply assume that, for purposes of analysis, the player is playing the game they designed. If the gap is acknowledged, it is

5. Salen and Zimmerman, *Rules of Play*, 316.

treated as a problem to be solved. If a player doesn't understand a game, it's because the game didn't do a good enough job of teaching him—the rules were too complicated, there wasn't enough feedback, the tutorials were inadequate, the learning curve was too steep.

I approach design somewhat differently. Rather than trying to eliminate gap between the game as understood and the game as encountered, I'm interested in *exploiting* it. I'm less interested in teaching the player the rules than in structuring an experience that will coax the player into constructing an interesting set of internal constraints. Some of these constraints may mimic the actual rules of the game, but most of them will not. The goal isn't for the player to play the game as designed or even the game as encountered, but rather for these two external systems to work together to guide the player toward a successful internal play space—the game as understood.

Here is a simple example. An important internal constraint in many games is "Don't let them see you." "They" may be palace guards, zombies, terrorists, or orcs—the fiction doesn't matter. In games to which this constraint applies, the player gains some advantage from hiding—he can sneak past enemies that are too tough to fight, or gain an edge in combat by setting up an ambush. "Don't let them see you" strongly favors some actions over others. It has a profound effect on how a player moves through the space, and can even generate long stretches of gameplay in which the player doesn't move at all.

The first thing to note about "Don't let them see you" is that it is a strategy, not a rule. The game software doesn't contain a single line of code that specifies "Don't let them see you" as a limit on the player's actions. Rather, "Don't let them see you" is an off-the cuff improvisation in response to a particular constellation of AI behaviors that *are* coded into the game's software.

Furthermore, the AI characters to whom the player is responding aren't capable of "seeing" anything. Their behavior is triggered by a series of line-of-sight checks; the game draws a line segment between the player and the AI character and tests to see if it intersects any world geometry. If it doesn't, then the AI can "see" the player. However, this form of "seeing" is very different from what happens when we see someone in the real world. In the real world, becoming aware of an object within our visual field is a complicated problem in pattern recognition. It can be confounded by motion, camouflage, lighting, fog, distractions, or simple lack of attention. It isn't a simple line-of-sight check.

If you pay close attention while playing a game, you can usually spot the gap between seeing and "seeing." You can "hide" behind a slender tree even though parts of your body are still visible. You can be "seen" even when you are in deep shadow. However, even when we are aware that this gap in our understanding, we don't play the game as designed. We don't move through the level thinking "If I stand here, that AI's line-of-sight check will fail." We still think in terms of *not being seen*.

The game is performing a clever bit of misdirection. We have years of experience with seeing things and being aware that other people are seeing us. Peek-a-boo is one of the first games we learn as babies. We play hide and seek, and cops and robbers. We learn how to drive, and how to flirt. Our conceptual background contains a wide assortment of different strategies for interpreting visual information and interpreting the intentions of others on the basis of the visual information we believe they possess.

Thus, the line-of-sight checks in a typical stealth game aren't set up as a rule system for us to learn. Rather, they are part of a collection of cues intended to coax us into borrowing a pre-existing strategic constraint from our conceptual background. We don't need a tutorial to teach us how to play the "Don't let them see you" game—we have been learning how to play that game since we were able to crawl. We just need a few hints to nudge us in the right direction.

The rules for AI behavior certainly play an important role in guiding us toward adopting "Don't let them see you" as an active strategy, but a number of less formal elements contribute: Does the enemy turn his head toward us when he sees us? Do our character's animations suggest that we are trying to be sneaky? Does the lighting of the level, or even the mood of the music imply that stealth would be fruitful?

Designers often draw a hard line between the rules of a game and its fantasy. Gameplay is seen as a product of the rules—the game's inner framework of restrictions and affordances. The fantasy is merely a pleasing "wrapper" that serves no gameplay purpose. How a character looks, how he is animated, how the world is lit, how it sounds—these things may be parts of the *overall* experience of the game, but they don't affect how the game *plays*. This is a mistake. A game's fantasy is as much a constraint on player action as its rules are. Seemingly inconsequential details, such as the sound of a footfall or the flutter of a piece of fabric, can have a profound effect on the strategies we adopt toward the situation that faces us. Game design is more than just inventing an interesting set of rules; it is structuring a total experience (both rules and fantasy) that will coax the player toward adopting an interesting set of internal constraints.

What internal constraints a player adopts will depend heavily on his conceptual background. Most players will stumble onto a strategy such as "Don't let them see you" relatively easily because "Don't let them see you" leverages basic intuitions about vision and intent that most of us developed in childhood. But we can't be sure whether less-universal strategies will be in the player's conceptual toolbox or not. "Control the high ground" isn't a strategy that most people learn as babies. Even more interesting, some players may know or invent strategies that the designer doesn't or didn't. The set of internal constraints that a player constructs in response to a game may not only be something that the designer didn't intend; it may be something that the designer didn't even imagine.

3 Play Spaces

The quality of a play space is determined by how its active constraints structure our immediate actions. Thus, if we want to understand how a play space works, we need to develop a set of tools that we can use to analyze these active constraints. A particularly useful abstraction for this purpose is the mathematical concept of a *phase space*. A phase space is a hypothetical space representing all possible states of a system, such that any particular state corresponds to a unique location within the space (figure 3.1). For example, an important element of the state of a game of ping-pong is the position of the ball. At any moment the position of the ball can specified by three numbers: its location from side to side, its distance from the net, and its height off the table. If we want to record the position of the ball, we can plot these three numbers as a point within a three-dimensional phase space. As the ball is batted back and forth, this point moves around in the phase space along a trajectory that mimics its path through real space.

However, if we really want to capture the state of a game of ping-pong, just specifying the position of the ball isn't enough. We also need to account for its velocity. After all, there is a big difference (in gameplay terms) between a ball that is moving left over the net and one that is moving right, even if they are both momentarily in exactly the same spot. Completely representing the speed and direction of the ball requires three more numbers. And if the players are putting "English" on the ball (as good ping-pong players do), the ball's spin is also an important part of the state of the game. Accurately representing the spin requires three more numbers.

Thus, the state of a ping-pong ball can be represented as a set of nine numbers. As the ball is batted back and forth, all nine of these numbers will be constantly fluctuating. We can think of the ball as tracing out a trajectory within a *nine-dimensional* phase space, each point within the nine-dimensional space representing a specific unique combination of location, velocity, and spin.

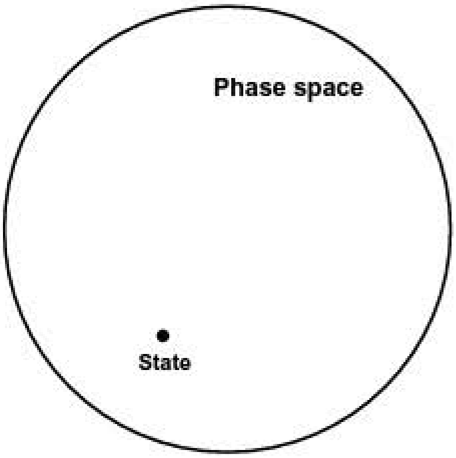

Figure 3.1
Phase space and a state within it.

It isn't possible to draw a nine-dimensional phase space on a two-dimensional page. But we can still use it as a conceptual tool. Phase spaces allow us to visualize every quantity that varies during a game as *movement from one location to another*. For human beings, this is a particularly powerful cognitive frame. Since early childhood we have constructed a number of strategies for understanding and influencing the movement of objects (including ourselves) from one location to another. Even though there are other types of change besides movement, *treating* all types of change *as* movement allows us to use these strategies. A phase space is an external constraint that coaxes us toward borrowing a typical set of internal constraints from our conceptual backgrounds. It is a way of structuring our discursive field to make it easier to say certain interesting and useful things about systems that change over time.[1]

When we talk about the phase space of a game, we aren't talking about a direct representation of the physical playfield. We are talking about a conceptual space with hundreds or even thousands of dimensions. Some of these dimensions may correspond to actual locations in our normal three-dimensional world, but most of them represent abstract quantities, such as the spin of a ball, how much grain your farmers have grown, or how many houses you have built on a property in *Monopoly*.

Depending on the game, the number of locations within the phase space can range from relatively small to unimaginably huge. On the simple end of the spectrum is tic-tac-toe. There are 765 unique arrangements of X's and

1. For more information on the use of spatial metaphors in cognition, see Johnson, *The Body in the Mind*.

O's that can occur during a game of tic-tac-toe. Every "move" will always result in one of those 765 states, so the phase space for tic-tac-toe has 765 locations. The phase space for chess, on the other hand, is considerably larger—it has been estimated to consist of roughly 10^{50} unique board positions.[2] And in games (such as basketball) in which the action isn't broken down into discrete moves, the phase space is effectively infinite.

The current state of a game is represented by a single point within its phase space. When you play a game, the state evolves over time, and that evolution can be represented by a line tracing a trajectory through the phase space. Points on the line are states that *did* occur; points off the line are states that *could have* occurred had you made different choices.

Once we are comfortable with the idea of a phase space, we can use it to help us understand the large-scale structure of different games (figure 3.2). Soccer, for example, has a fairly open structure. The players can roam freely around the field, and similar configurations of offense and defense can recur in the course of a match. The same rules and physical constraints apply throughout. A simple bubble with a wandering trajectory that crosses and re-crosses itself is a reasonably adequate model of this sort of homogenous gameplay.

Chess is a different matter. Because the number of pieces dwindles as the match progresses, the phase space of chess has *directionality*. Some states are accessible only at the beginning of a match, others only at the end. The origin of the trajectory is a single point. Every game of chess begins with the same configuration of pieces on the board. As the match progresses, the trajectory gradually wanders away from the origin and toward states that

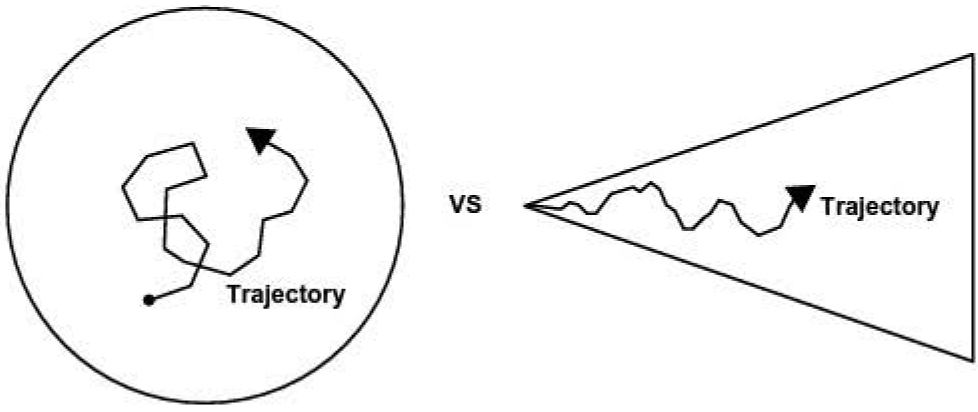

Figure 3.2
The trajectory of play in soccer vs. that in chess.

2. Allis, *Searching for Solutions in Games and Artificial Intelligence*, 171.

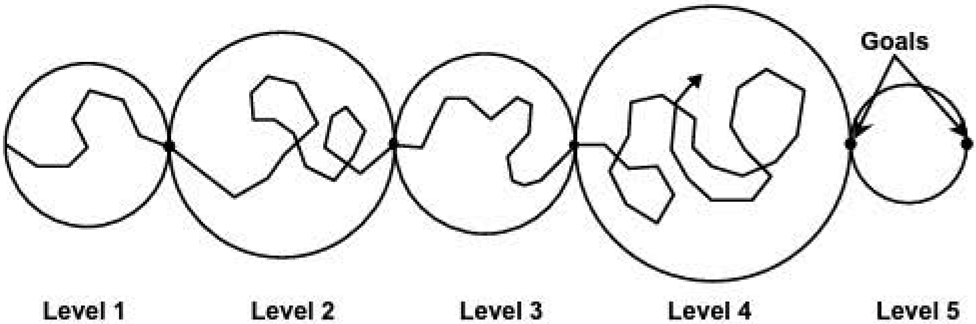

Figure 3.3
The phase space of a typical videogame.

contain fewer and fewer pieces. Previous configurations are rarely revisited, and moves at the end of the game are very different from the moves at the beginning.

Goals

Videogames often combine free-form and directional phase spaces. Many of them have multiple levels. Within each level, the player is free to explore, but the transitions between levels impose rigid gates between the free-form bubbles (figure 3.3).

A diagram of a videogame's phase space helps to illustrate an important point—the idea of *goals*. A goal is simply a privileged configuration of the game's state. It is a particular arrangement of playing pieces (either real or abstract) that is afforded some special status. Examples include putting a ball in a net, placing the opposing king in checkmate, and navigating to the end of a level.

If we look at our diagram for the phase space of a level-based videogame, we see that the action within each level terminates with a goal. What this goal is will differ from game to game. It may be reaching the end of the level alive, killing a particular enemy, or clearing away all the blocks in *Tetris*. In each case, reaching the goal means that the player has succeeded in putting the state in a particular desirable configuration.

A goal functions as a constraint. By privileging a particular configuration of the play space, the goal focuses the players' actions. Movement within the other constraints is then directed toward bringing about the desired configuration. For example, the goal in *go* is to control more territory than your opponent, so on every turn the players tend to pick moves that are likely to maximize their territorial gains.

A goal can exert either a positive or a negative influence. Rolling your bowling ball into the gutter, landing on a property owned by another player, dying in a videogame—these are goals too. But rather than configurations that the player is working to achieve, they are configurations the player is working to *avoid*.

Goals tend to be very powerful constraints.[3] Many rules exert their influence only in certain contexts. For example, baseball has rules governing how runners may behave while rounding the bases (they must stay within the base paths, they must not interfere with the ball while it is in play, and so on), but these constraints are active only when there are men on base. When the bases are empty, the rules governing base runners recede into potentiality. But the overall goal of baseball—to score more runs than the other team—is active throughout the entire game. Every action taken on the field is shaped and directed by this particular overarching constraint.

Failing to respect the goals of a game often triggers the same negative response as failing to honor any of the other rules. "You're letting me win!" carries the same level of disapproval as "You're cheating!" even though the transgression is to the benefit of the aggrieved party. This suggests that the feelings of outrage we feel when we think we have been cheated are less about the loss of relative advantage than about transgression of the play space.

In order for the choices we make within a system of constraints to feel as if they matter, there must be different degrees of desirability assigned to different locations in the phase space. Some outcomes must be good, others bad. Most commercial games accomplish this through brute force. Their formal rules simply present players with explicit goals. However, not all play spaces work this way. For example, when children play make-believe, they aren't working toward one specific outcome; rather, new goals are improvised on the fly in response to the flow of the fantasy—for example, "Now goblins are attacking the fort! We have to defend it!" Similarly, you can have fun in an open-world videogame, such as *Grand Theft Auto* or *Red Dead Redemption,* without working toward any particular mission or objective. Weaving in and out of traffic for the hell of it and sitting on a hilltop idly taking potshots at crows are fun in these games, even though the self-imposed goals that drive them don't figure in the formal reward structure.

3. "Games have a lot of rules—how to move and what you can and cannot do—but there is one rule at the foundation of all the others: The Object of the Game." Schell, *The Art of Game Design,* 148.

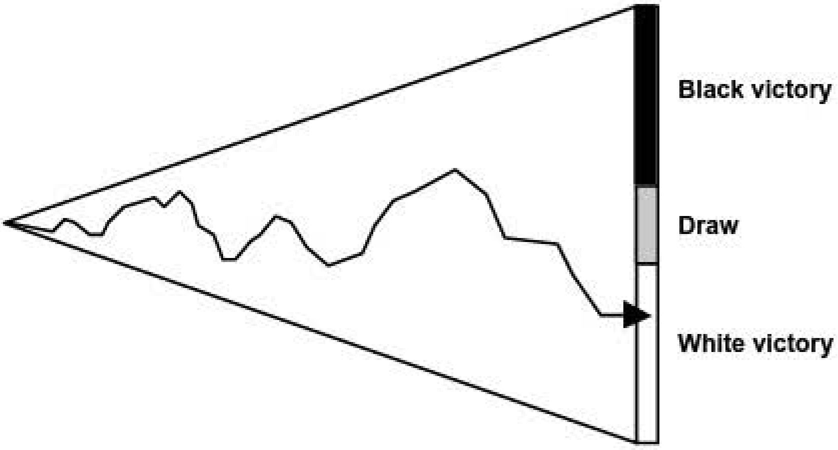

Figure 3.4
Goals in the phase space of chess.

In the absence of formal victory conditions (and sometimes in defiance of them), players often invent their own constraints to privilege certain locations within a game's phase space. Years ago, I spent several enjoyable hours with a group of friends building human pyramids in a session of *Quake*. We certainly had a goal—maximizing the number of characters we could stack on top of each other (I think we managed six). But it was a goal of our own invention, entirely distinct from the normal objective of racking up the most kills.

Figure 3.4 illustrates the phase space of chess with goals added in. There are multiple configurations that result in victory for one side or the other. And there are also some configurations that result in a draw—victory for neither side. In a competitive game, the positive goals for one player are the negative goals for the other. In the figure, black is working toward checkmating the white king, white toward preventing it.

In chess, a draw is less desirable that a victory but more desirable than an outright loss. Thus, a configuration that results in a draw can be either a positive or a negative outcome, depending on the current state of the game. If you are close to victory, a draw is a negative goal—something to be avoided. But if you are close to defeat, a draw becomes a positive goal—something to work toward.

As was discussed in chapter 2, when a player formulates a strategy we can think of that strategy as just another form of constraint. These constraints are often expressed as goals—interim configurations of the state that are either desirable or undesirable. Consider the strategy "Make sure you have full ammo and health before you start the final boss battle." Achieving full ammo and health then becomes an interim goal that exerts a strong tug on the trajectory of play immediately before the boss battle.

One major difference between a novice player and an expert is the expert's knowledge of interim goals. The expert knows that certain configurations of the game state are advantageous and works to achieve them, whereas the novice is capable only of responding to the immediate challenges of the moment. The expert's knowledge imposes an additional set of constraints on his trajectory through the phase space. He may avoid certain actions not because the game forbids him from doing them, but because he knows from experience that they are worthless or counterproductive—they lead to undesirable locations in the game's phase space. Similarly, an expert may pursue certain lines of action even though they appear to be disadvantageous in the short run, because he knows that in the long run they are likely to lead to desirable outcomes.

The Horizon of Action

Each point within a game's phase space represents a particular configuration of the game's state. But because the game's active constraints are determined by the game's state, we can think of each point in the phase space as also representing a particular set of active constraints. As play proceeds along a trajectory through the phase space, these active constraints will shift and change.

Furthermore, the active constraints at any point in the phase space determine where the trajectory of play can go next. The player can't just hop to any configuration of the state he wants. The rules constrain which future configurations are allowed. And the player's beliefs and strategies constrain which future configurations are desirable.

We can think of every point in the phase space as having a *horizon of action* (figure 3.5). The horizon of action is the set of all states attainable by the player within the near future. And this horizon is determined, not surprisingly, by the set of active external constraints associated with the current state.[4]

4. The "horizon of action" is related to Jauss' "horizon of expectation." In Jauss' reception theory, a "horizon of expectation" is the cultural context of a reader's interpretive acts. The relationship between these two concepts will become more apparent later in this book. However, readers who are familiar with Jauss' work should be aware that they aren't equivalent. The horizon of action operates on a shorter time scale than Jauss' horizon of expectation, and encompasses more possible constraints. For more on the horizon of expectation, see Jauss, *Toward an Aesthetic of Reception*.

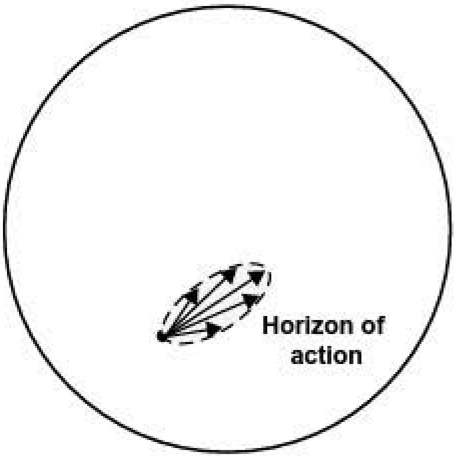

Figure 3.5
The horizon of action.

Suppose you are playing a classic two-dimensional "platformer," such as *Donkey Kong*. The current level consists of a set of platforms that you can reach by jumping. As you move around within the level, you are tracing a path within the game's phase space. At any moment there will be some platforms that you can reach in the near future and others that are inaccessible to you. Whether a particular platform is accessible or not is governed by the architecture of the level and the jumping abilities of your character—these are the external active constraints that define your horizon of action.

Note that your horizon changes as you move around within the level. Depending on your location, the level geometry will constrain your movement in different ways. Sometimes you will be presented with a very narrow range of potential actions; sometimes your range of options will be very wide. Each different point in the phase space has its own horizon. Typically, however, states that are similar to each other will tend to have similar horizons. If you shift your character a few pixels to the left you will occupy a slightly different point in the phase space, but your horizon of action will remain virtually unchanged.

Thus, we can think of the player's trajectory through the play space not merely as a series of different configurations of the state, but as a series of different opportunities for action. As the player moves through the game, his horizon of action shifts and changes. At any moment, he is offered a range of potentially achievable outcomes. On the basis of his actions, one of those potential outcomes becomes the new state. That new state defines a new horizon—a new range of potentially achievable outcomes. The cycle of gameplay continues, each evolution of the state defining a new horizon and each horizon constraining the next evolution of the state (figure 3.6).

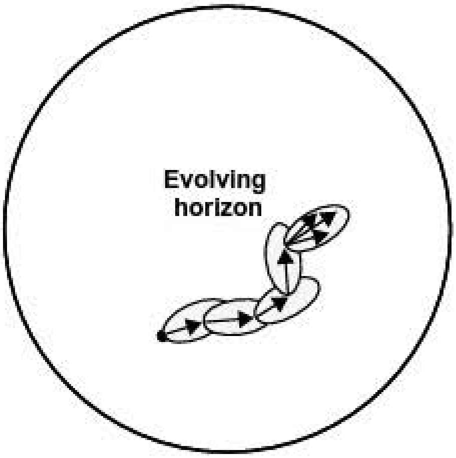

Figure 3.6
The evolving horizon of action.

Some states within a game may be unstable—that is, may change even if the player does nothing at all. Picture a soccer ball rolling down the field. Even if the players stand completely still, the state of the game is still changing. And as the state changes, the horizon of action—the set of possible states that a player can achieve in the near future—also changes.

Unstable states are important in many videogames. The current state of the game is used by the rules to determine what the state of the game should be in the near future, and that new state leads to another and another in an ongoing chain. This evolution of the state occurs continuously, even if the player puts his controller down and walks out of the room. This property is particularly obvious in simulation games, such as *SimCity*. It is possible to "play" *SimCity* without providing any inputs at all for long stretches of time. The rules are set up so that the state will evolve in interesting ways even without a player's intervention. Even a relatively minor input from a player can trigger an unfolding cascade that may take many minutes to play out. Most real-time videogames have such internal loops, though they may not be as obvious as those in *SimCity*. When you put down the controller, the state of the game continues to change (usually in ways that lead to losing). The *Tetris* blocks continue to fall. Your car stops while the others roar around the track. Your knight stands with his sword by his side while the battle swirls around him.

The Horizon of Intent

The term *horizon of action* describes the set of all the things a player can do at a particular moment. But often the set of things we *believe* we can do is more important for analyzing gameplay that the set of things we *can* do. For example, if I believe that a platform is too far away, I will not try to jump to it even if in fact it lies within my horizon of action. Similarly, if I believe that a platform is close enough to jump to, then I might try to jump to it even though in fact I will not be able to reach it.

Thus, each point in the phase space, in addition to having a horizon of action, also has a *horizon of intent*. The horizon of intent is the set of all states that the player believes to be valid, attainable, and desirable in the near future. It is defined by the player's current set of active internal constraints. The horizon of intent is a product of the game as understood, whereas the horizon of action is a product of the game as encountered.

Some of the constraints defining the horizon of intent will be internalized approximations of external constraints. For example, if I am playing baseball there is no physical barrier preventing me from running directly from home plate to second base when I get a hit. But my knowledge of the rules blocks that particular action. Similarly, my knowledge of a videogame's level geometry means that I will avoid obstacles before I collide with them. I know that the obstacles exclude certain locations in the level from my horizon of action, and I adjust my horizon of intent to match.

But other constraints in the horizon of intent have no external analogues. I may avoid doing certain things not because they aren't possible or because they are against the rules, but because I know that they are tactically unwise. I could stand still in the batter's box after getting a hit in baseball; however, I don't, because that would make it easier for an opposing player to tag me out. I could run straight into the maw of a boss during a boss battle; however, I don't, because I know that would get my character killed. My horizon of intent is defined not just by what I believe I *can* do, but also by what I believe I *should* do—my internal strategic constraints.

The internal constraints defining my horizon of intent will also include any goals I have adopted. These may be internalized versions of external objectives supplied by the rules of the game, they may be interim goals constructed on the fly as part of some strategy, or they may even be purely idiosyncratic inventions that run counter to the grain of the designer's intent for the play space.

The horizons of action and intent have to overlap at least a little for a game to be playable (figure 3.7). You can't play a platformer if you aren't aware that you can jump. At least a few of your apparent choices must correspond to valid actions. However, for gameplay purposes, it turns out that it's also a good thing if your apparent choices don't match valid actions too closely. In fact, one of the reasons why many games have unstable states

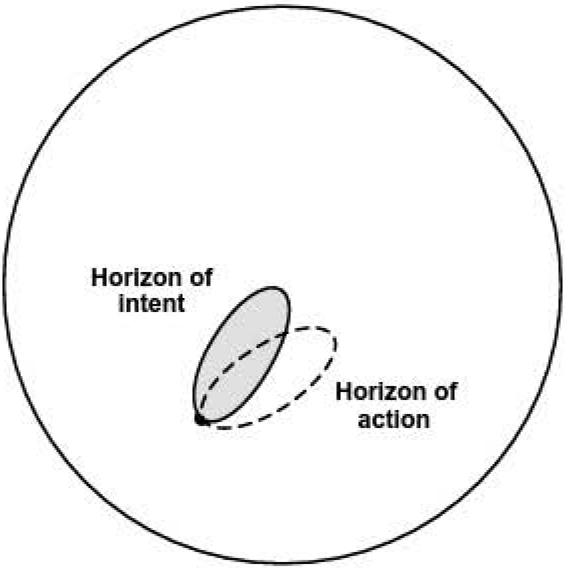

Figure 3.7
The overlapping horizons of intent and action.

is that they encourage the divergence of the two horizons. If your opportunities for action are constantly changing, your awareness of what those opportunities are (and their relative worth) will necessarily lag a bit behind. This may seem counterintuitive at first. Shouldn't one goal of game design be to ensure that the player understands the rules of the game clearly? The answer is "Yes and no." It turns out that some degree of uncertainty about the consequences of our actions is necessary if a system of constraints is going to function as a successful play space. We will explore why this should be so in much greater detail in the next chapter. For present purposes, it is sufficient to keep in mind that what the player believes he can or should do in a game (the player's horizon of intent) will almost always differ somewhat from what the rules of the game actually allow (his horizon of action).

Narrowing our focus to the horizons of intent and action gives us a way to grapple with the tremendous complexity of a game's full phase space. There may be 10^{50} unique positions within the play space of chess, but at any moment during a game only a few dozen lie within the horizon of action. And since many of these will be rejected as tactically unwise by expert players, the typical horizon of intent in a game of chess contains only a few moves. If we are interested in analyzing gameplay, these two horizons give us a way to talk about the moment-to-moment texture of the encounter while allowing us to ignore huge chunks of the play space that don't affect a player's immediate experience.

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